Application Note AN 2014-06
V1.1 January 2015

EVALPFC-3kW-IPZ65R019C7

3kW PFC Evaluation Board

IPZ65R019C7 with CCM PFC controller

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Edition 2011-02-02
Published by
Infineon Technologies Austria AG
9500 Villach, Austria
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AN 2014-06
Revision History: 14-03-01, V1.0; 15-01-08, V1.1
Previous Version: V1.0
Subjects: V1.1: Typing errors corrected

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General safety instruction

Warning: The evaluation board works with high voltage which could be deadly for the users. Furthermore all circuits on the board are not isolated from the line input. Due to the high power density, the components on the board as well as the heat sink can be heated to a very high temperature which can cause a burning risk when touched directly. The users should be engineers and technicians who are experienced in power electronics technology and make sure that no danger or risk may occur while operating this board.

Note: After the operation of the evaluation board, the DC-Link Capacitors C21 and C24 may still store a high energy for several minutes, which is indicated by the lighting of the LED1. So the C21 and C24 must be first discharged till the LED1 does not light before any directly touching of the board.

Note: The board is designed for a maximum input current of 16A. To operate it at a mains input of 90VAC, the output power must be correspondingly reduced so that the maximum current limit is not exceeded.

Note: The normal output power of the board is designed up to 3kW so that the device temperature stays below 80°C. Users can operate the board to a peak output power of 3500W. However it is not recommended to operate at this output power level longer than 2 minutes. In this case, the device temperature of the MOSFET (DUT1) and/or Diode (DUT1) can reach above 100°C. Be care for the burning risk!

Note: The EMC filter on the board is designed to cover a wide range of applications according to the standard CISPR 14. Nevertheless the EMC of the board is strongly dependent on the different application settings and load conditions. Users may modify the EMC filter or using other methods like wire shielding to make the individual applications fulfil the standard. To fulfil other possible dedicated standards required by different applications, users may have to apply extern components themselves.

Note: The evaluation board is designed according general electric roles. Never the less will Infineon Technologies not guarantee any fulfillment of local certificate requirements ore recommendations according norms. Therefore the usage of the evaluation board is on your own risk.

To get started

Step 1: Complete connections “V_{in}”, “V_{out}”& “KL01”

- V_{out} : Connect with an output load which is available to operate at 400V DC
- V_{in} : Connect L, N and Earth to the 90VAC…265VAC mains power supply
- KL01 : Optional DC-Power that power up the cooling fans externally →see Thermal concept

Step 2: Switch on the mains power supply and check the Vout for the 400V DC

Step 3: For more instructions please refer to the following guideline.

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1 Introduction

1.1 Evaluation Board

This document describes the evaluation board EVALPFC-3kW-IPZ65R019C7, which is designed for the customers to evaluate the performance of the TO247-4pin CoolMOSTM C7 family. The board is developed for the laboratories use only and does not serve for any commercial purpose! **Before operating the evaluation board, please read the general safety instruction section first!**

The aim of this document is to help the customers to get familiar with the evaluation board EVALPFC-3kW-IPZ65R019C7 to investigate the different behavior of conventional 3pin devices compared to the high performance TO247-4pin CoolMOS™ devices within a PFC application. Therefore the document focuses on the different options offered by the special layout and variation options.

Following table gives the main technical specifications of the evaluation board:

Input voltage	85VAC~265VAC
Input current	16A eff
Input frequency	47~63Hz
Output voltage and current	400VDC, 8A
Output power	~ 3kW (at Vin=230VAC)
Average efficiency	>95% at 115VAC
Switching Frequency	Possible Range: 40kHz~250kHz; Board frequency is set to 100kHz; Changeable by R20
Power switch	4pin and 3pin MOSFET

1.2 CoolMOS™ C7

CoolMOS™ C7 (IPZ65R019C7) achieves extremely low conduction and switching losses per package. The extremely low switching losses enable the designer the option for higher switching frequencies in order to shrink the magnetic components and increase the power density.

E_{oss} reduction brings efficiency benefits at light load and the low Q_g correlates to faster switching and lower E_{on} and E_{off} which gives efficiency benefits across the whole load range.

As well as balancing the various parameters to give the best-in-class performance, measures were taken to even improve implementation/ease of use behavior compared to the CoolMOS™ CP series.

Moreover, with its granular portfolio, C7 can address the specific needs of hard switching applications for server, PC power, telecom rectifiers and solar. C7 offers the best in class performance on the market today with lowest $R_{DS(on)}$ per package together with 650V to give extra safety margin for designers.

1.3 thinQ!™ SiC Diode Generation 5

thinQ!™ Generation 5 silicon carbide diode (IDH16G65C5) represents Infineon's leading edge technology for SiC Schottky Barrier diodes. The Infineon proprietary diffusion soldering process, already introduced with G3, is now combined with a new, more compact design and thin wafer technology. The result is a new family of products showing improved efficiency over all load conditions, coming from both the improved thermal

characteristics and a lower figure of merit (Q_c*V_f). More than this it offers also increased dv/dt robustness up to 100V/ns which enables very fast switching. This is perfect fit to the fast switching CoolMOS™ C7 family.

1.4 CCM-PFC Controller

The evaluation board presented here is a 3kW power factor correction (PFC) circuit with 85~265VAC universal input and output of 400VDC. The continuous conduction mode (CCM) PFC controller ICE3PCS01G is employed in this board to achieve the unity power factor.

This ICE3PCS01G is specially designed for applications of power supplies used in PC, server, and Telecom, requesting high efficiency and power factor. The voltage loop compensation is integrated digitally for better dynamic response and less design effort. Appreciated for its high integrated design, ICE3PCS01G can achieve full requirements of the PFC application implemented in the 14-pin in DSO14 package. At the same time the number of peripheral components is minimized. The gate switching frequency is adjustable from 21kHz to 250kHz and able to synchronize with external switching frequency from 50kHz to 150kHz.

1.5 Gate Driver ICs (EiceDRIVER™ Compact)

Infineon EiceDRIVER™ family (IEDI60N12AF) offers a wide range of CT based gate drivers that supporting for all topologies using CoolMOS™ in 3- and 4pin packages. CT utilizes on-chip coupled inductors realized in the existing metal layers to transmit the gate drive signals from the input to the output stage with isolation of more than 1200V provided by a thick inter-metal oxide. This approach offers high speed and very good common-mode transient immunity, which is crucial to driver the MOSFET with fast voltage transients.

With the use of IEDI60N12AF on this evaluation board, the benefits of Infineon's TO-247 4pin package can fully demonstrate very fast switching behavior parallel to clean gate waveforms. Base on the CT technique, the Kevin source can be completely isolated from the power source. Higher efficiency and better system stability can be achieved.

The 6A driving capability of the driver output helps and is necessary to switch the 19mOhm CoolMOS™ very fast. Even if the board will be used with higher ohmic devices, there it is of advantage to have a very strong driving capability in order to minimize gate oscillation at fast switching.

The output of the driver is featured with separate Out+ and Out- for ease tune the turn on and turn off behavior of the MOSFET by using different gate resistors connected to the different outputs without any diode for separating turn on and turn off phase.

In the present evaluation board the two output pins are put together. This is due to the fact that the parallel design for 3- and 4-Pin devices caused already 2 different changeable gate resistors. In order to keep the complexity on low level, the design did not take the opportunity to separate turn on and turn off gate resistors as this is not that much important for efficiency analyses.

Furthermore this driver is the only known driver up to now, which has a CMTI (common mode transient immunity) of dv/dt =>100V/ns which is needed for high transition noise feedback from the drain to the gate signal at fast switching mode.

2 Application

The demo board described within this document is based on a CCM PFC (continuous conduction mode power factor correction) as shown the principle schematic below.

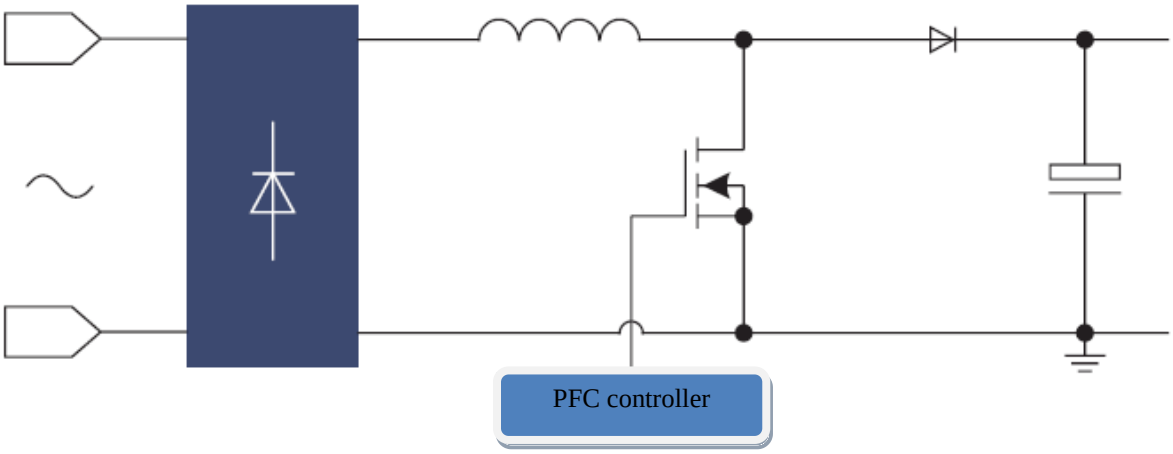


Figure 1: Schematic of the topology

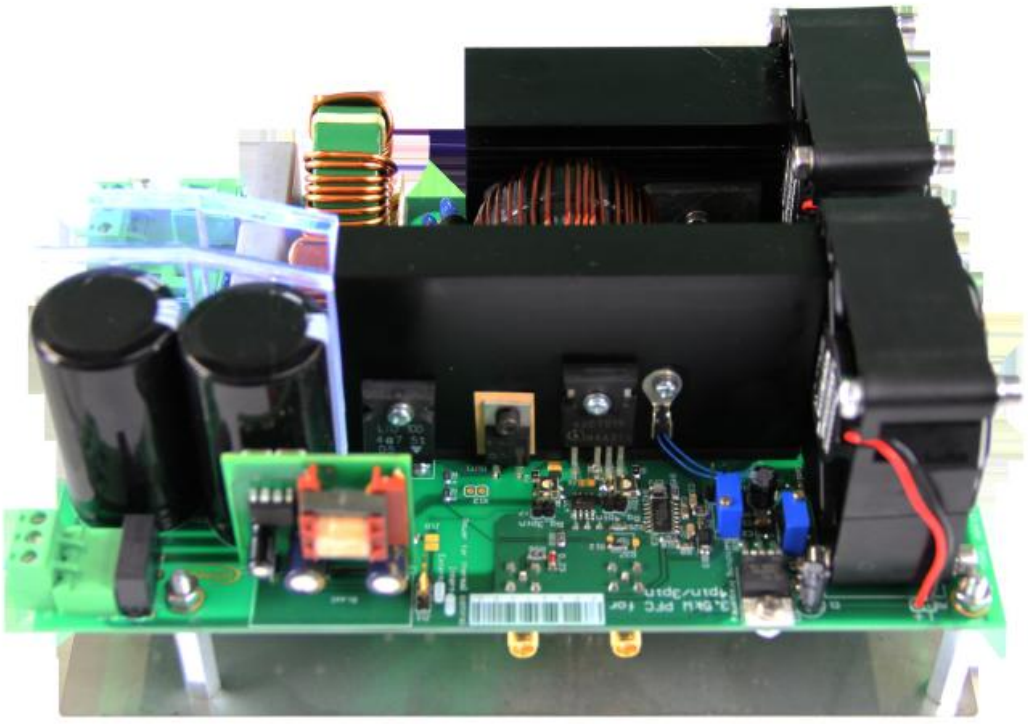


Figure 2: IPZ65R019C7 Evaluation board

3 Circuit Description

3.1 Line Input

The AC line input side does not include any input fuse. Please ensure proper external over-current protection. The input is fitted with 2 connectors in order to offer proper input voltage measurement for high precisely power metering. The choke L3, X2-capacitor C4/C5/C23 and Y1-capacitors C17/CY18 are used to suppress common mode noise as well as differential mode noise. R_NTC2 is placed in series to limit inrush current during each power on. A relay is mounted across the R_NTC2 to short the resistor when V_{OUT} is higher than ~60V.

3.2 Power Stage – Boost Type PFC Converter

After the bridge rectifier GL1 and GL2, there is a boost type PFC converter consisting of L1, IPZ65R019C7, IDH16S65C5, C30, C8, C21 and C24,. The seventh generation CoolMOS™ IPZ65R019C7 and the SiC Diode IDH16S65C5 share the same heat sink so that the system heat can be equably spread. Output capacitor C30, C8, C21 and C24 provides energy buffering to reduce the output voltage ripple (100Hz at 50Hz AC input) to the acceptable level and meet the holdup time requirement.

3.2.1 Separate Source Power MOSFET

Infineon's TO-247 4pin package enables significant efficiency improvements in hard switching topologies for CoolMOS™ high voltage Power MOSFETs. The fourth pin acting as a Kelvin source can be used to reduce the parasitic inductance of the source lead of the power MOSFET.

The benefit will be seen in various hard switching topologies such as Continuous Conduction Mode Power Factor Correction (CCM PFC), Boost and Two Transistor Forward (TTF). The new package offers improved

efficiency by reducing switching losses up to 8% which equates to 3,5W of saved power in a CCM Mode PFC running at 1.2KW, which is equal to 0,3% extra full load efficiency compared to the same MOSFET in the standard 3pin TO-247 package.

The evaluation board is available to test the physical same device in either 3 pins or 4 pins (with sense source) configuration. The standard setting of the set-up is 4 pin configuration. To change the testing device to 3 pins configuration, it is necessary to open the connection point J7 and connect the solder point J8 or J6. Please check chapter 9 on page 17 for more detail information.

3.3 PWM Control of Boost Converter

The ICE3PCS01G is a 14-pins control IC for power factor correction converters. It is suitable for wide range line input applications from 85 to 265 V_{AC} with overall efficiency above 97%. The IC supports converters in boost topology and it operates in continuous conduction mode (CCM) with average current control.

The IC operates with a cascaded control; the inner current loop and the outer voltage loop. The inner current loop of the IC controls the sinusoidal profile for the average input current. It uses the dependency of the PWM duty cycle on the line input voltage to determine the corresponding input current. This means the average input current follows the input voltage as long as the device operates in CCM. Under light load condition, depending on the choke inductance, the system may enter into discontinuous conduction mode (DCM) resulting in a higher harmonics but still meeting the Class D requirement of IEC 1000-3-2.

The outer voltage loop controls the output bulk voltage, integrated digitally within the IC. Depending on the load condition, internal PI compensation output is converted to an appropriate DC voltage which controls the amplitude of the average input current.

The IC is equipped with various protection features to ensure safe operating condition for both the system and device.

3.4 Thermal concept

The evaluation board is fitted with different thermal management for the two different heat sinks mounted on the board. The concept for the input bridge rectifier is designed only for cooling with adjustable fan speed. It

is possible to optimize this fan between noise generation and cooling effect by changing the changeable resistor R28 nearby the fan for the bridge rectifier.

The main heat sink for the DUT offers cooling and heating functionality in parallel. For heating up the heat sink to target temperature (standard setting=60°C) it is necessary to

- remove the external connection from KL01 GND to Vout_sense GND
- Change the setting of Jumper J11 from “Intern” to “Extern”.
- Supply galvanic isolated 12V to connector KL01 between GND and +12V with current limit of 1A
- Supply 17V to connector KL01 “Heating” with current limitation of 3.5A

The control circuit will than heat up the heat sink to the adjusted temperature which can be changed by the changeable resistor R3 and once the temperature is reached it will start the fan to cool again. So it is possible to operate the Application with regulated heat sink temperature for the MOSFET and the DIODE.

4 Circuit Operation

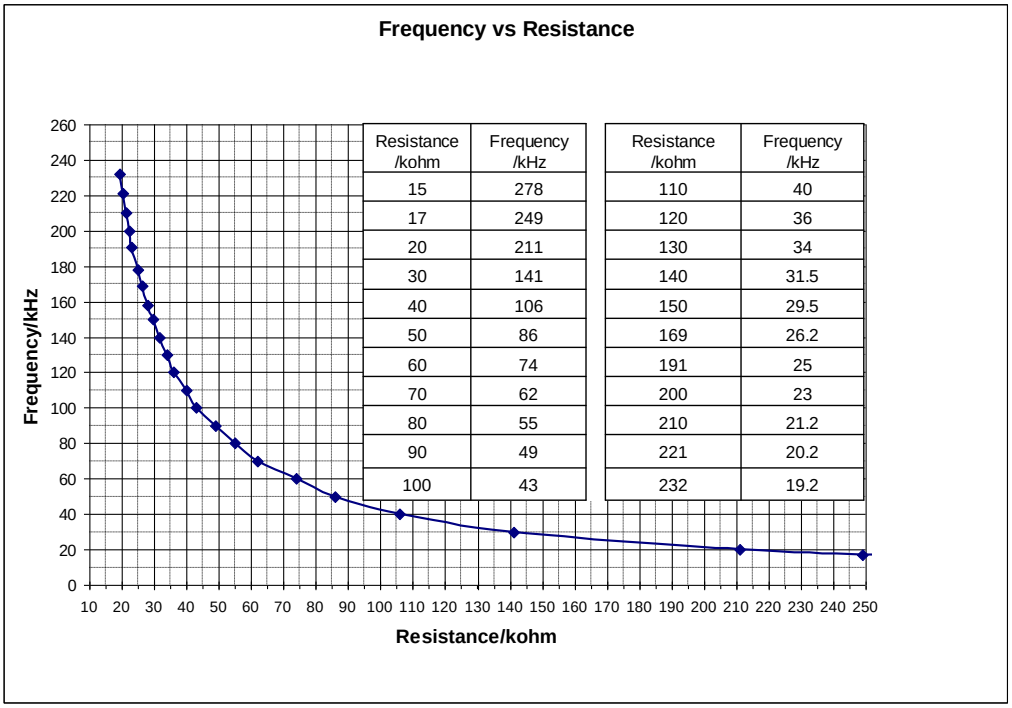
4.1 Soft Startup

During power up when the V_{OUT} is less than 96% of the rated level, internal voltage loop output increases from initial voltage under the soft-start control. This results in a controlled linear increase of the input current from 0A thus reducing the current stress in the power components.

Once V_{OUT} has reached 96% of the rated level, the soft-start control is released to achieve good regulation and dynamic response and VB_OK pin outputs 5V indicating PFC output voltage in normal range.

4.2 Gate Switching Frequency

The switching frequency of the PFC converter can be set with an external resistor R_{FREQ} at pin FREQ with reference to pin SGND. The voltage at pin FREQ is typical 1V. The corresponding capacitor for the oscillator is integrated in the device and the R_{FREQ}/frequency is given in Figure 2. The recommended operating frequency range is from 21 kHz to 250 kHz. As an example, a R_{FREQ} of 43kΩ at pin FREQ will set a switching frequency F_{SW} of 100 kHz typically.



Resistance /kohm	Frequency /kHz	Resistance /kohm	Frequency /kHz
15	278	110	40
17	249	120	36
20	211	130	34
30	141	140	31.5
40	106	150	29.5
50	86	169	26.2
60	74	191	25
70	62	200	23
80	55	210	21.2
90	49	221	20.2
100	43	232	19.2

Figure 3: Frequency setting

The switching frequency can be changed by the changeable resistor R31. For easy adjustment please consider to use the connection pins X8 to measure the value when the evaluation board is not connected to mains.

4.3 Protection Features

4.3.1 Open loop protection (OLP)

The open loop protection is available for this IC to safe-guard the output. Whenever voltage at pin VSENSE falls below 0.5V, or equivalently V_{OUT} falls below 20% of its rated value, it indicates an open loop condition (i.e. VSENSE pin not connected). In this case, most of the blocks within the IC will be shutdown. It is implemented using a comparator with a threshold of 0.5V.

4.3.2 First over-voltage protection (OVP1)

Whenever V_{OUT} exceeds the rated value by 8%, the first over-voltage protection OVP1 is active. This is implemented by sensing the voltage at pin VSENSE with respect to a reference voltage of 2.7V. A VSENSE voltage higher than 2.7V will immediately block the gate signal. After bulk voltage falls below the rated value, gate drive resumes switching again.

4.3.3 Peak current limit

The IC provides a cycle by cycle peak current limitation (PCL). It is active when the voltage at pin ISENSE reaches -0.2V. This voltage is amplified by a factor of -5 and connected to comparator with a reference voltage of 1.0V. A deglitcher with 200ns after the comparator improves noise immunity to the activation of this protection. In other words, the current sense resistor should be designed lower than -0.2V PCL for normal operation.

4.3.4 IC supply under voltage lockout

When V_{CC} voltage is below the under voltage lockout threshold V_{CCUVLO}, typical 11V, IC is off and the gate drive is internally pull low to maintain the off state. The current consumption is down to 1.4mA only.

4.3.5 Bulk Voltage Monitor and Enable Function (VBTHL_EN)

The IC monitors the bulk voltage status through VSENSE pin and output a TTL signal to enable PWM IC or control inrush relay. During soft-start once the bulk voltage is higher than 95% rated value, pin VB_OK outputs a high level. The threshold to trigger the low level is decided by the pin VBTHL voltage adjustable externally.

When pin VBTHL is pulled down externally lower than 0.5V most function blocks are turned off and the IC enters into standby mode for low power consumption. When the disable signal is released the IC recovers by soft-start.

5 Circuit Diagram

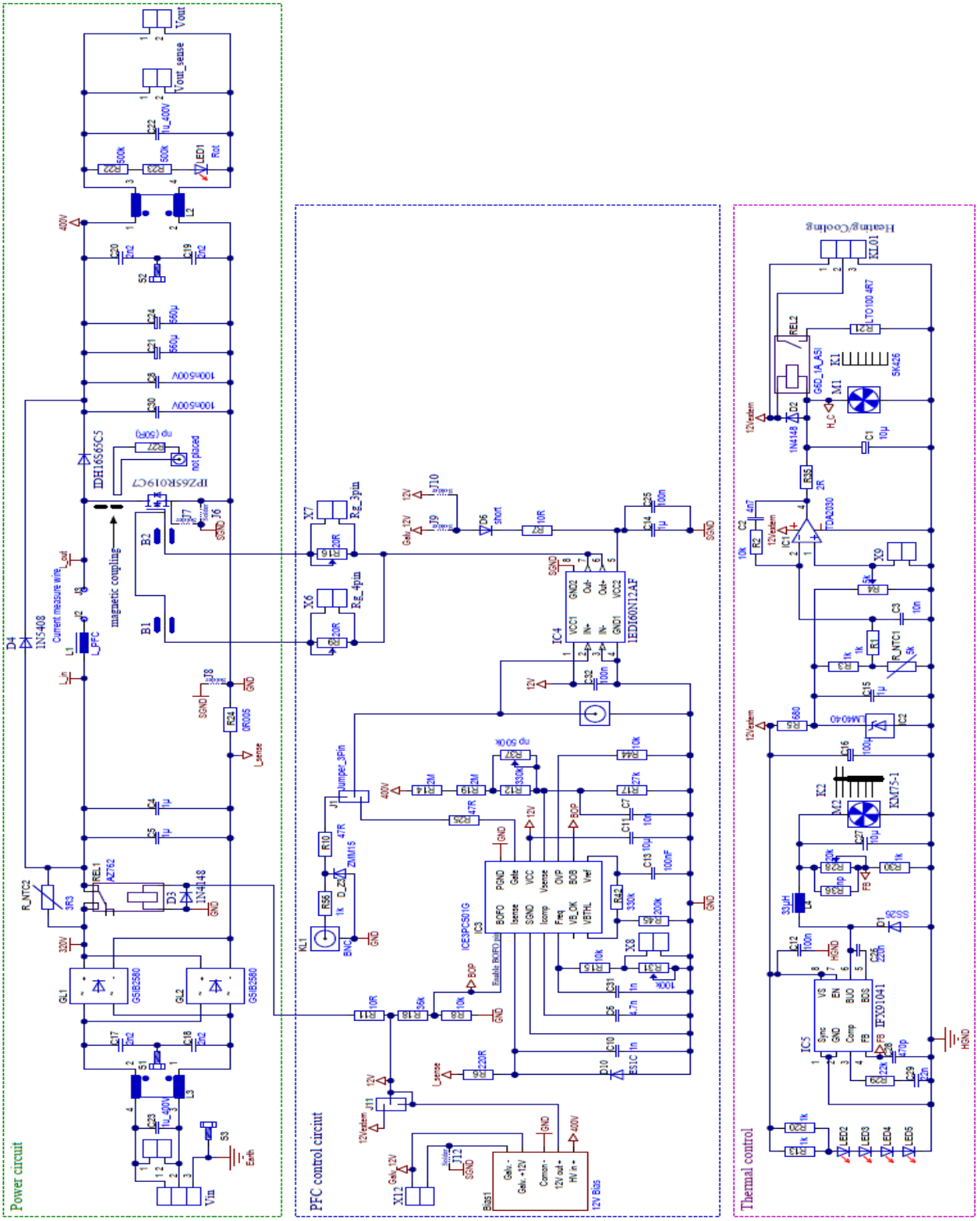


Figure 4: Whole evaluation board schematic

6 PCB Layout

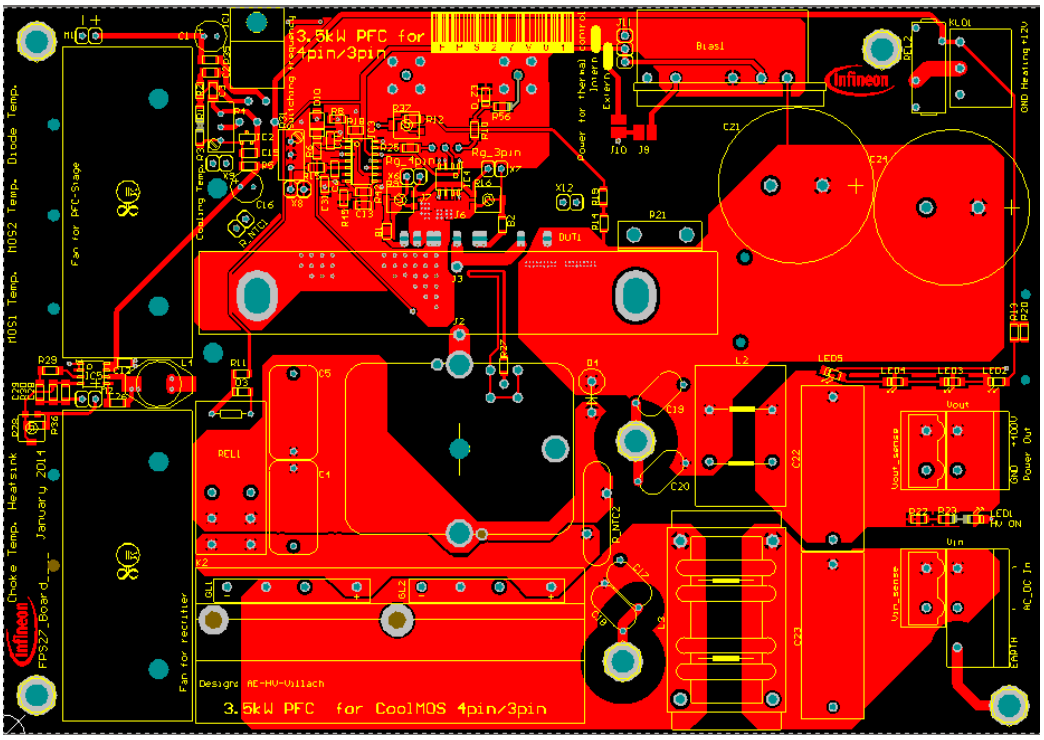


Figure 5: PCB top layer view

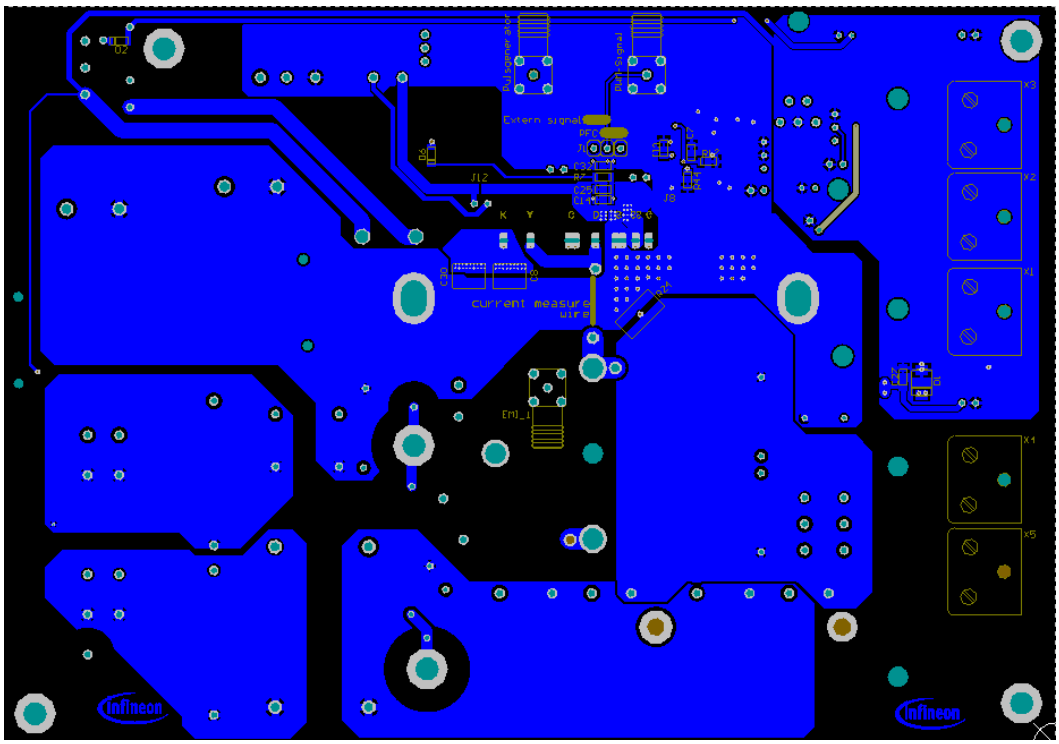


Figure 6: PCB botom layer view

7 Component List

Designator	Value	Description
B1, B2	closed with 0Ohm	Placeholder for Ferrite Bead, 0Ohm resitor
Bias1	12V Bias	Bias adapter
C1	10µ	25V
C2	4n7	25V
C3	10n	25V
C4, C5	1µ	x-capacitor
C6	4.7n	25V
C7	10n	25V
C8, C30	100n500V	VJ1825Y104KXEAT
C10, C31	1n	25V
C11	10µ	25V
C12, C25, C32	100n	25V
C13	100nF	25V
C14, C15	1µ	25V
C16	100µ	25V
C17, C18, C19, C20	2n2	Y-capacitor
C21, C24	560µ	EETHC2G561KA or EKMR421VSN561MR50S
C22, C23	1u_400V	BFC237351105; Farnel 1215540
C26	220n	25V
C27	10µ	25V
C28	470p	25V
C29	22n	25V
D1	SS26	
D2, D3	1N4148	
D4	1N5408	
D6	short	0Ohm
D10	ES1C	1A150V Fast Diode
DUT1	IPZ65R065C7	
D_Z3	ZMM15	1N4734A
EMI_1	not placed	EMI Adapter
GL1, GL2	GSIB2580	GSIB2580

IC1	TDA2030	Mount with M2.5x6
IC2	LM4040	LM4040D20IDBZRG4
IC3	ICE3PCS01G	PFC_CCM_Controller
IC4	1EDI60N12AF	6A_isolated_MOSdriver
IC5	IFX91041	1.8A Step down switching regulator
J1, J11	Jumper_3Pin	SPC20486
J2	Strombruecke	1.25mm isolated copper wire
J3	BOHRUNG	U-schape-Cu-wire 1.25mm 2cm distance
J6	open	Solderjumper; 4pin as 3pin
J7, J12	close with solder	Solderjumper;driver ground to SS, Solderjumper; isolated driver power
J8, J10	open	Solderjumper; 3pin ground, Solderjumper; driver power none isolated
J9	close with solder	Solderjumper; isolated driver power
K1	SK426	100mm long; mound with 2xM4x15
K2	KM75-1	KM75-1 +4clip 4597; Fischer
KL1	BNC	SMA connector
KL01	HV in	GMSTBVA 2,5 HC/ 3-G-7,62
KL01-S	Complement	GMSTB 2,5 HCV/ 3-ST-7,62
KL02	Vin_sense	GMSTBVA 2,5 HC/ 2-G-7,62
KL02-S	Complement	GMSTB 2,5 HCV/ 2-ST-7,62
L1	L_PFC	2times 77083A7 64wind_1.15mm
L2	10A100µH	Würth 744824101
L3	8120-RC	BOURNS_8120-RC_2m4H_17A
L4	33µH	74454133
LED1	red	Power on LED
LED2, LED3, LED4, LED5	blue	Power on LED
M1, M2	Fan 60mm	PMD1206PTB1-A
M1, M2	finger guard for Fan 60mm	LZ28CP
PWM-Signal	SMA	SMA connector
R1, R3, R13, R20, R56	1k	5%
R2, R8, R15, R44	10k	5%
R4	5k	67WR20KLF
R5	680	5%

R6	220R	5%
R7, R11	10R	5%
R9, R16	20R	3314G-1-200E
R10, R25	47R	5%
R12, R42	330k	5%
R14, R19	2M	5%
R17	27k	5%
R18	36k	5%
R21	LTO100 4R7	include two 20F2617 Bürklin connector
R22, R23	500k	10%
R24	0R005	FCSL90R005FE
R27	np	
R28	20k	23AR20KLFTR
R29	22k	5%
R30	1k	10V
R31	100k	67WR100KLF
R35	2R	5%
R36	np	
R37	np 500k	5%
R45	200k	5%
REL1	AZ762	12V
REL2	G6D_1A_ASI	12V
R_NTC1	5k	B57560G502F mound in K1 under MOS
R_NTC2	3R3	R_SL22
S1, S2, S3, S4, S5, S6	SCREW_M4	3cm Distanceholder
S1, S2, S3, S4, S5, S6	Mutter M4	M4 Screw nut
S1, S2, S3, S4, S5, S6	Unterlegscheibe M4	washer M4
Vin	HV_in	GMSTBA_2.5HC_3G7.62
Vout	Vout	GMSTBA_2.5HC_2G7.62
Vout_sense	Vout_sense	GMSTBVA_2.5HC_2G7.62
X1	np (Heat sink)	Thermal measurement connector
X2	np (MOS1)	Thermal measurement connector
X3	np (Diode)	Thermal measurement connector
X4	np (Choke)	Thermal measurement connector

X5	np (MOS2)	Thermal measurement connector
X6	Rg_4pin	SPC20485
X7	Rg_3pin	SPC20485
X8, X9	KL_STANDARD_2	SPC20485
X12	np	for adapter power supply

8 Boost Choke Layout

The boost choke on this evaluation board is self winded since this is not a volume production. It consists of 2 stacked “Kool Mμ” toroids cores with the partnumber 77083A7. As a result of the 64windings with 1.15mm copper wire the inductance at 100kHz is about 600μH. As the inductance and the magnetic flux optimum is depending on the switching frequency and the output power, it might be needed to be changed if the evaluation board is used for changed setting in power and frequency.

Figure 7: Main inductor

9 Source connection options

The source connection for the MOSFET-Gate drive can be set to different options. It is important to make sure that only one of the Jumper 6, 7 and 8 is closed at the same time. In Figure 8 the possibilities on top side of the PCB are shown. For Standard trough hole packages one can put as much solder on the 2 surface area of J6 that there is a electrical connection if a low inductive gate driving is wanted. For Standard gate drive inductance it is possible to close J8 (see Figure 9) on bottom side of the PCB instead J6 .

To investigate the performance advantages of the 4pin solution please activate J7 on top side of the PCB. This will totally separate the gate drive circuit from the power path and therefore result in cleanest gate drive wave forms.

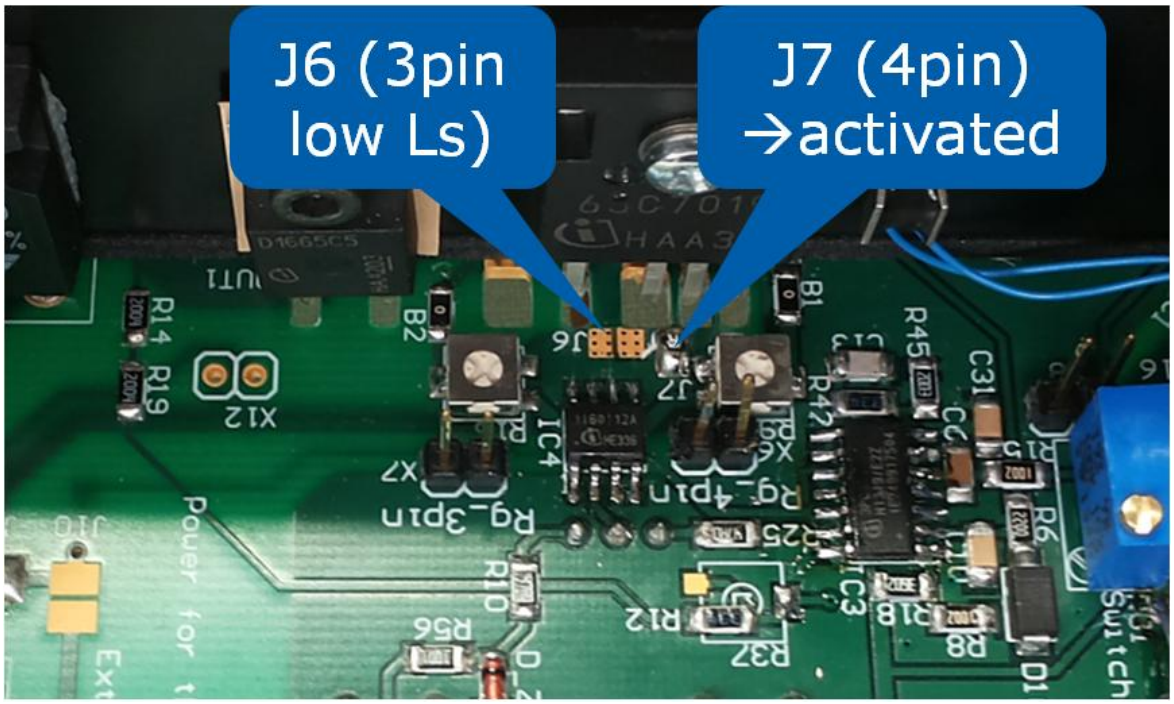


Figure 8: Source connection setting on top side for source sense and low inductance 3pin option

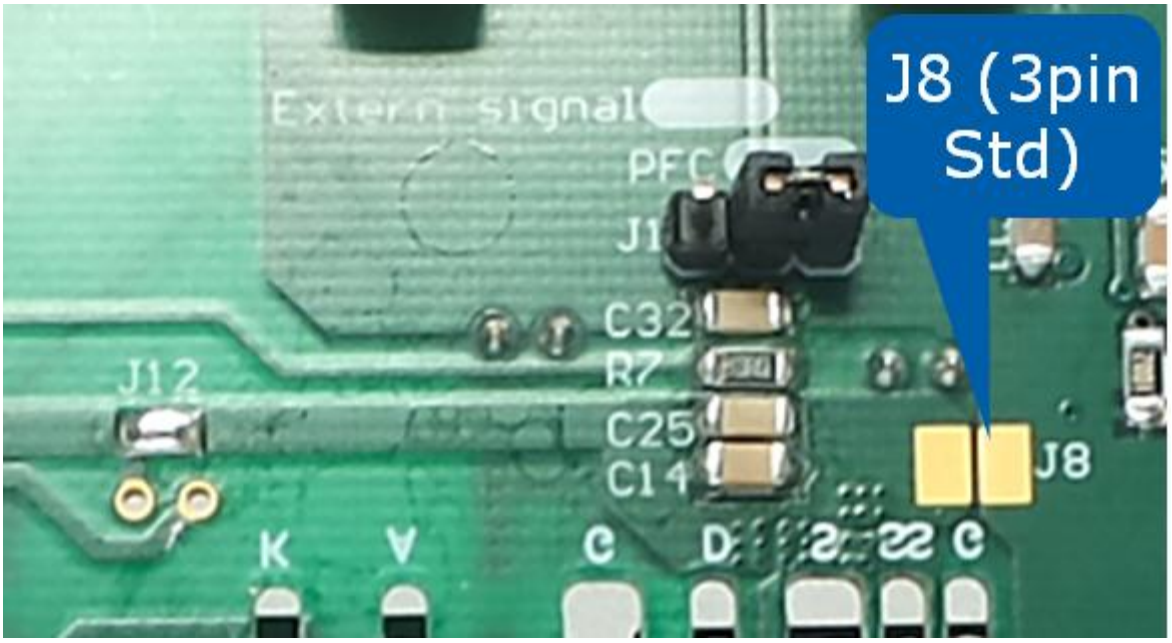


Figure 9: Source connection setting on bottom side for standard 3pin

10 Test report

All test condition are based on 60°C heat sink temperature.

For the efficiency test it is important to take the voltage sensing on the input and output power with the Vin_sense and Vout_sense right beside the power connections.

10.1 Load and Line Test

Input	V_{IN}	I_{IN}	P_{IN}	U_{OUT}	I_{OUT}	P_{OUT}	Eff.	PF
85Vac	84.87	1.5715	131.26	400.89	0.3001	120.21	91.58159	0.9842
	84.8	3.0311	255.33	400.9	0.5996	240.27	94.10175	0.9934
	84.73	4.5068	380.53	400.86	0.9002	360.71	94.79148	0.9965
	84.66	5.991	506.1	400.89	1.2004	481.1	95.06027	0.9978
	84.58	7.486	632.1	400.89	1.4992	600.8	95.04825	0.9983
	84.51	8.997	759.4	400.87	1.7993	721	94.94338	0.9988
	84.44	10.522	887.6	400.87	2.1001	841.6	94.81749	0.999
	84.37	12.063	1016.8	400.89	2.399	961.4	94.55153	0.9991
	84.29	13.621	1147.2	400.88	2.6993	1081.8	94.29916	0.9991
	84.21	15.191	1278.3	400.89	2.9969	1201.1	93.96073	0.9992
230Vac	229.65	1.3798	310.35	400.89	0.7479	299.78	96.59417	0.9794
	229.72	2.6986	615.7	400.89	1.4978	600.4	97.51502	0.9931
	229.66	4.0199	919.8	400.89	2.2452	900	97.84736	0.9963
	229.6	5.3548	1226.3	400.88	2.9956	1200.8	97.92057	0.9975
	229.54	6.692	1533.3	400.85	3.7472	1501.9	97.95213	0.9982
	229.47	8.027	1839.4	400.87	4.4934	1801	97.91236	0.9986
	229.41	9.373	2147.7	400.88	5.2446	2102.1	97.8768	0.9988
	229.34	10.725	2456.8	400.87	5.993	2402.1	97.77353	0.9988
	229.28	12.076	2765.9	400.82	6.74	2701.1	97.65718	0.999
	229.21	13.437	3076.9	400.88	7.489	3001.6	97.55273	0.999

Out of the table one can see, that the full load efficiency is improved by only changing from 3pin to 4pin configuration. Due to this advantage it can be possible to replace a current 3pin PFC stage with a MOSFET of one step higher $R_{DS(on)}$. This will help to increase the efficiency all over the power range beside full load at low line. Therefore it will help to enter into the TITANUM Standard for server SMPS.

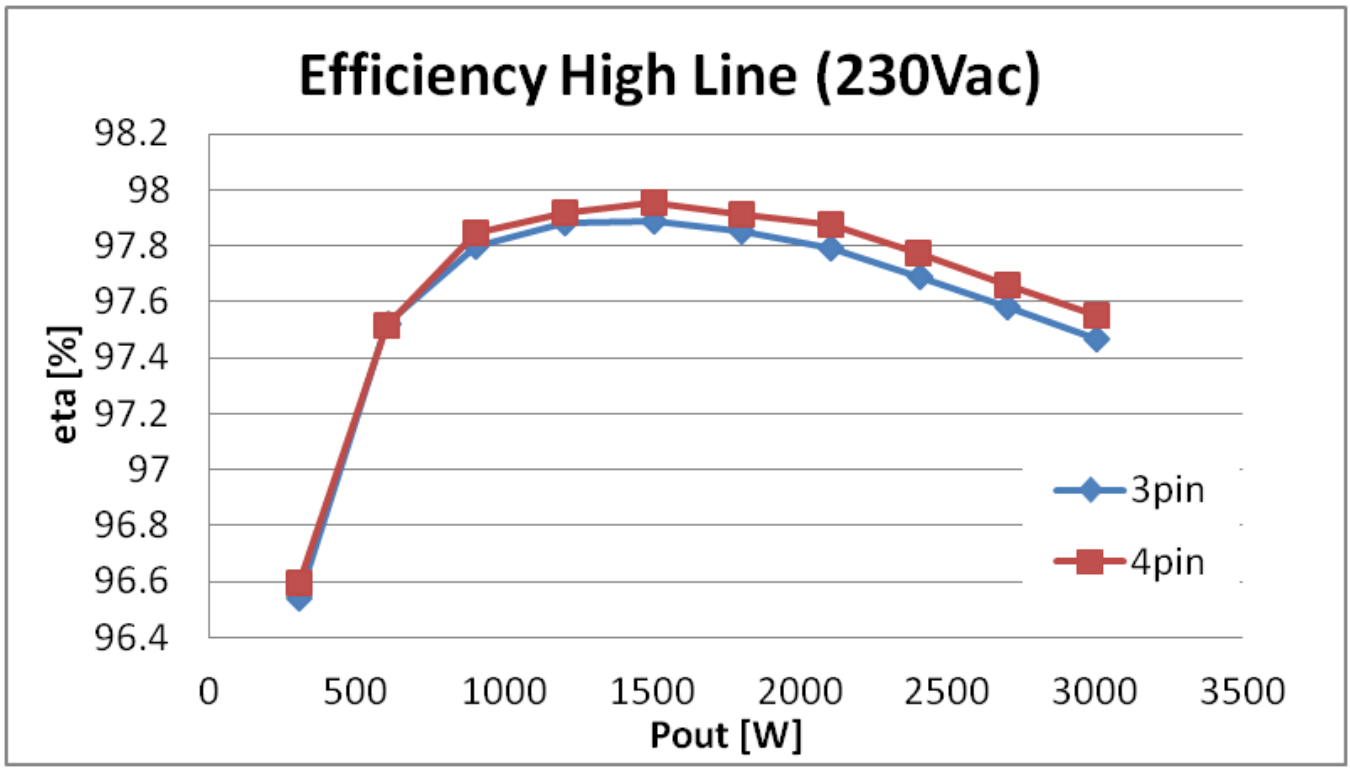


Figure 10: High line efficiency with IPW65R019C7 & IDH16G65C5 @ 100kHz 1.8ohms

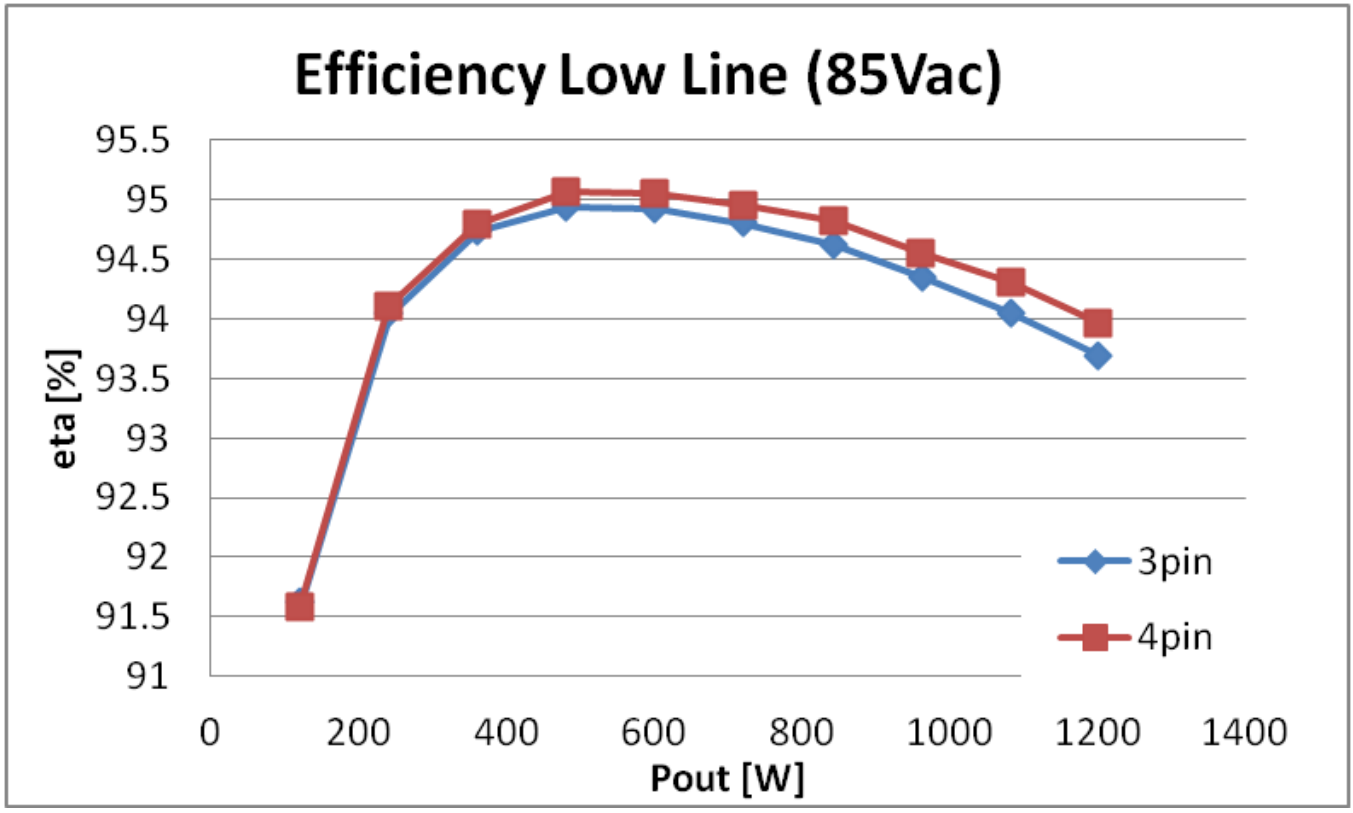


Figure 11: Low line efficiency with IPW65R019C7 & IDH16G65C5 @ 100kHz 1.8ohms

10.2 Conductive EMI Test

EMI is a very important quality factor for a power supply. The EMI has to consider the whole SMPS and is splitted into radiated and conductive EMI consideration. For the described evaluation PFC board, it is more important to investigate on the conducted EMI-behavior since a PFC is the input stage of any SMPS with input power above 75 watts or greater.

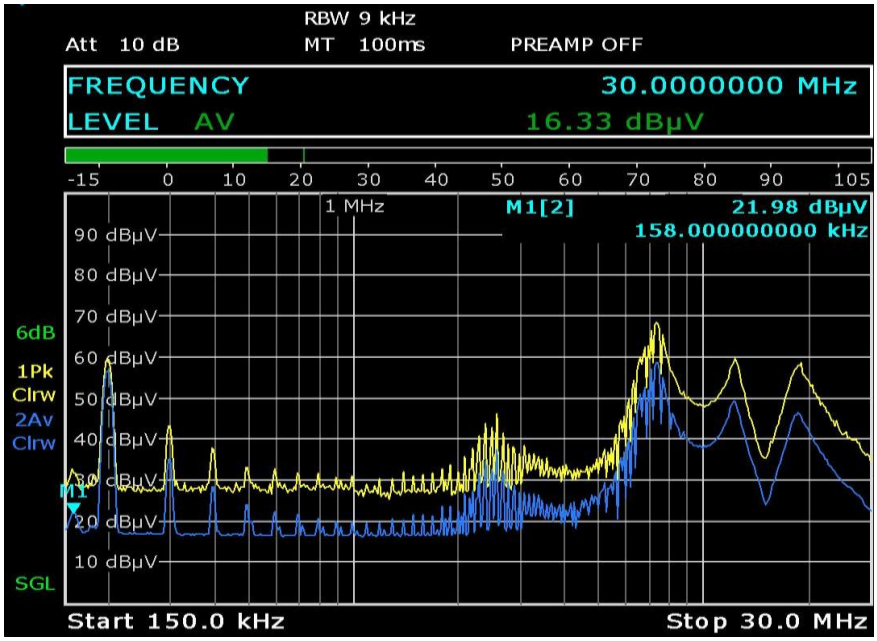


Figure 12: Conductive EMI Measurement of the Board with resistive load

Base on the EN55022 standard, the line filter can be modified as below in order to improve the EMI quality further more:

- Change the Y1-capacitors C17/C18 from value 2.2nF to 1.1nF
- Change the Y1-capacitors C19/C20 from value 2.2nF to 3.3nF
- Change the X2-capacitor C23 from value 1uF to 1.5uF

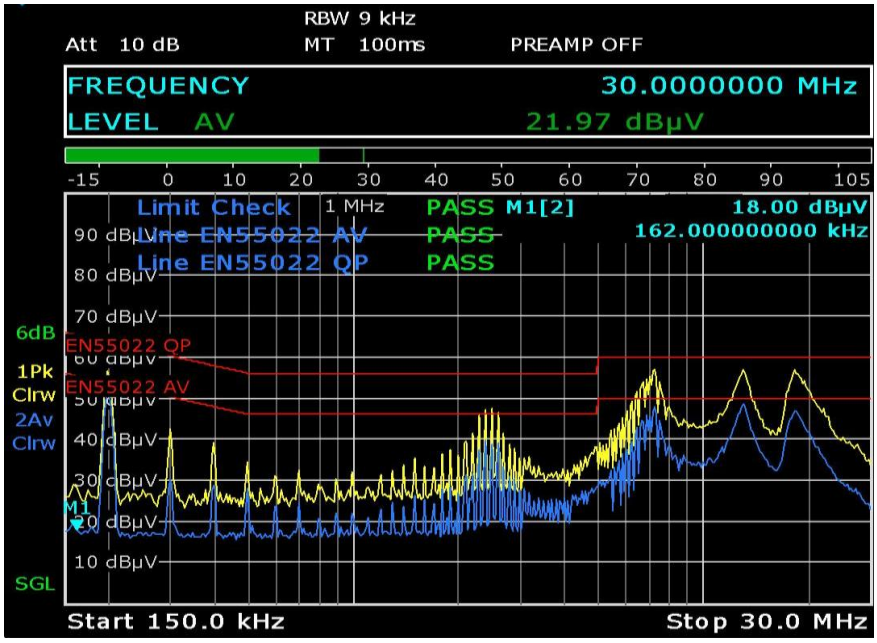


Figure 13: Conductive EMI Measurement of the Board with resistive load after modification

10.3 Startup behavior

During power up when the V_{OUT} is less than 96% of the rated level, internal voltage loop output increases from initial voltage under the soft-start control. This results in a controlled linear increase of the input current from 0A thus reducing the current stress in the power components as can be seen on the yellow wave shape in Figure 14.

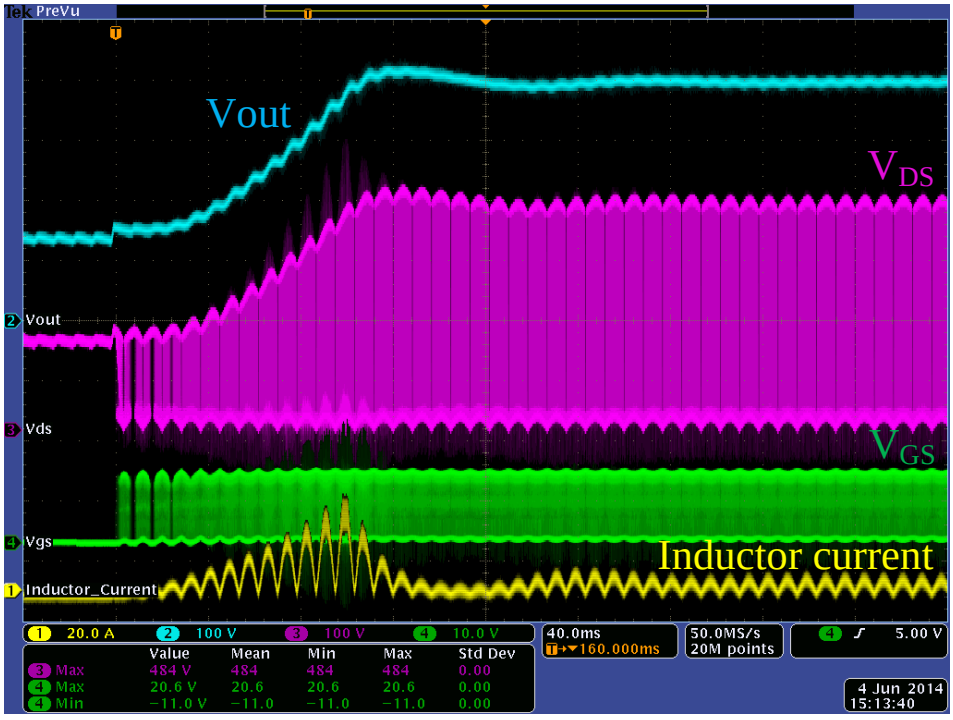


Figure 14: Soft startup at 1kw

11 Conclusion

The 3kW PFC Evaluation Board described in this document is aimed to analyze the switching performance of different variants of packages in a very common used PFC topology. It helps to understand the switching behavior and parasitic influences. With the various option settings via “solder jumper” it is possible to modify the circuit without changing any layout. Therefore the evaluation board offers lots of investigation variants. Furthermore it shows how to boost the efficiency in a standard PFC topology.

12 References

[1] ICE3PCS01G Datasheet, Infineon Technologies AG, 2010.

[2] 650V CoolMOS™ C7 Power MOSFET, Product Brief, Infineon Technologies AG, 2013.

[3] IDH16G65C5 , Datasheet, Infineon Technologies AG, 2012.